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Man-Ho JAE et al.	:	Group Art Unit: 1763
Serial No. 10/087,855	:	Examiner S. MacArthur
Filed March 5, 2002	:	

TITLE: METHOD AND APPARATUS FOR POLISHING A SUBSTRATE WHILE WASHING A POLISHING PAD OF THE APPARATUS WITH AT LEAST ONE FREE-FLOWING VERITCAL STREAM OF LIQUID

SUBMISSION OF ENGISH LANGUAGE TRANSLATION OF FOREIGN-LANGUAGE PRIORITY APPLICATION

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that I am thoroughly conversant in both the Korean and English languages;

that I am presently engaged as a translator in these languages;

that the attached document represents an accurate English translation of Korean Patent Application No. 2001-15655, filed March 26, 2001.

Signed this 2nd day of Aug., 2004.

Yong Woo Park
(signature of translator)

THE KOREAN INDUSTRIAL

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This is to certify that annexed hereto is a true copy from the records of the Korean Industrial Property Office of the following application as filed.

Application Number : Patent Application No. 2001-15655

Date of Application : March 26, 2001

Applicant : Samsung Electronics Co., Ltd.

Dated this: April 30, 2001

COMMISSIONER

PATENT APPLICATION

Applicant : Name: Samsung Electronics Co., Ltd.
(Representative: Jong-Yong YUN)

Address : 416 Maetan-dong, Paldal-gu, Suwon-city, Kyungki-do, Republic of Korea

Agent(s) : Young-Woo PARK

Inventor(s) : Name : JAE, Man Ho
Address : 112-506 Wooman Jukong Apt., 29 Wooman 2-dong, Paldal-gu, Suwong-si, Gyeonggi-do, Korea

Name : KIM Min Gyu
Address : A-402 Hana Village, 153-182 Maetan 1-dong, Paldal-gu, Suwon-si, Gyeonggi-do, Korea

Title of the Invention : METHOD AND APPARATUS FOR POLISHING A SUBSTRATE

Dated this: April 30, 2001
To the COMMISSIONER

[ABSTRACT]

There is disclosed an improved method and apparatus for polishing a substrate with polishing pad and slurry. The substrate is polished mechanically by the slurry and the abrasive surface of the polishing pad, and polished chemically by the chemical materials included in the slurry. The washing liquid for removing the pollutants generating from the polishing process and the slurry is flowed onto the polishing pad freely and vertically. Due to free and vertical flow, the washing liquid is not rebounded and flows down on the surface of the polishing pad.

[REPRESENTATIVE FIGURE]

FIG. 6

[SPECIFICATION]

[TITLE OF THE INVENTION]

METHOD AND APPARATUS FOR POLISHING A SUBSTRATE

[BRIEF EXPLANATION OF THE DRAWINGS]

The above and other objects and advantages of the present invention will become readily apparent with reference to the following detailed description when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic view for showing a state wherein the surface of a substrate is polished by means of a polishing apparatus;

FIG. 2 is a cross sectional view showing a washing member mounted on the conventional polishing apparatus;

FIG. 3 is a schematic cross-sectional side view illustrating the spray of deionized water using a washing member of FIG.2;

FIG. 4 is a perspective view illustrating an apparatus for polishing a substrate according to a preferred embodiment of the present invention;

FIG. 5 is a perspective view of a polishing pad of FIG.4;

FIG. 6 is a schematic cross-sectional side view showing a washing member for the apparatus for polishing a substrate according to a preferred embodiment of the present invention;

FIG. 7 is a perspective view of a washing member of FIG.6;

FIG. 8 is a schematic cross-sectional side view of slurry dispenser mounted on a washing member of FIG.6; and

FIG. 9 is a schematic diagram illustrating the spray of washing liquid according to a preferred embodiment of the present invention.

[PROPOSE OF THE INVENTION]

[THE AREA TO WHICH THE INVENTION PERTAINS AND THE PRIOR ART]

The present invention relates to a method and an apparatus for polishing a substrate, which uses a polishing pad and slurry, and more particularly to minimizing a defect caused by slurry rebounding to the component of apparatus and falling down of stacked slurry to the polishing pad.

Recently, as information media including computers are widely used, the semiconductor industry makes great strides. In the functional aspect, a semiconductor device is required to be operated at a high speed and to have a large storing capacitance. Accordingly, the semiconductor manufacturing technique is developed to improve the integration degree, reliance and response speed of the semiconductor device.

Chemical mechanical polishing (CMP) is a manufacturing technology for improving the integration degree of the semiconductor device, which was developed in nineteen eighties. The CMP is polishing technology to get surface flatness by polishing a film on the surface of substrate.

Examples of the polishing technologies are disclosed in U.S. Patent No. 5,709,593, issued to Guthrie et al. and in U.S. Patent No. 6,051,499, issued to Tolles et al.

FIG. 1 is a schematic view for showing a state wherein the surface of a substrate 10 is polished by means of a polishing apparatus.

Referring to FIG. 1, substrate 10 is catched by carrier head 12 which can simultaneously rotate and oscillate. The substrate 10 is contacted with rotatable polishing pad 14 which is mounted on a platen 13, and substrate 10 is polished by the

slurry 16 which is sprayed on the polishing pad 14. In this polishing process, the substrate 10 is polished mechanically by abrasives included in the slurry 16 and the abrasive surface of polishing pad 14, and polished chemically by the chemical materials included in the slurry 16.

In the above polishing process, particles generated by the polishing process and slurry used for the polishing process remain on the polishing pad. When polishing the substrate, these remaining particles and slurry on the polishing pad cause a defect. Therefore, in the above stated polishing process the particle and slurry have to be removed while polishing the substrate 10.

FIG. 2 is a cross sectional view showing a washing member mounted on the conventional polishing apparatus for polishing a substrate.

Referring to FIG. 2, the washing member 20 is the shape of arm, and includes nozzles 21, 22, 23, 24, 25 to spray deionized water 30 onto the polishing pad 22. Slurry dispenser 40 which supplies slurry 32 onto the polishing pad 22 is installed to the washing member 20 and slurry outlet 34 is located at the end of the washing member 20.

The slurry dispenser 40 has various shapes and various methods of function. For example, a slurry dispenser disclosed in U.S. Patent No. 5,928,062, issued to Miller et al, includes several slurry outlets and supplies slurry through each of the several slurry outlets. The several slurry outlets have the shape of nozzle or hole. The nozzle has a function of spraying slurry and the hole has a function of dropping slurry. Another slurry dispenser, disclosed in Japanese Patent Laid-open No. Hei 5-343375, is mounted on the polishing pad itself and supplies slurry onto the polishing pad.

During the polishing, the washing member 20 sprays deionized water 30 through

the nozzle 21, 22, 23, 24, 25 onto the polishing pad, which makes the particles and slurry remaining on the polishing pad 22 to be removed. In other words, the sprayed deionized water 30 flows down from polishing pad 22 carrying the remaining particles and slurry, and so, the remaining particles and slurry are removed. In Addition to the removing particles and slurry during polishing, the washing member 20 has a function of cleaning the polishing pad 22 by supplying deionized water 30 continuously after the finish of the polishing a substrate.

FIG. 3 is a schematic cross-sectional side view illustrating the spray of deionized water using a washing member of FIG.2.

Referring to FIG. 3, the deionized water 30 sprayed onto the polishing pad 22 is rebounded from the surface of polishing pad 22, which is caused by the pressure from the nozzle 21 when deionized water 30 is sprayed. And moreover, the slurry remaining on the polishing pad 22 is also rebounded together with the rebounding 30a of the deionized water. The remaining slurry is rebounded 30a onto the washing member 20 itself and all of component comprising apparatus for a polishing, and the rebounded slurry is to be stacked on the washing member 20 and the component of polishing apparatus.

The stacked slurry causes a defect of substrate during polishing process. The rebounded slurry is not easily cleaned, especially when being rebounded into the component of the polishing apparatus, and is to be stacked as time flows. Accordingly, the stacked slurry falls down onto the surface of the polishing pad constantly and works as particles scratching surface of the substrate during polishing process. Therefore, the rebounded slurry works as a persistent defect source of substrate while the substrate is polished.

In a short, the slurry rebounded together with the rebounding of the deionized water works as a constant defect source and after being stacked works as particles. And so, the stacked slurry persistently causes a defect of a substrate during polishing process and the defect of a substrate damages the reliability of the semiconductor device.

[TECHNICAL OBJECT OF THE INVENTION]

The present invention has been made to solve the above-mentioned problem, and accordingly it is a first object of present invention to provide a method of polishing a substrate which can minimize rebounding of washing liquid supplied on the polishing pad.

It is a second object of the present invention to provide an apparatus for polishing a substrate which can minimize rebounding of washing liquid supplied on the polishing pad.

[CONTRUCTION AND OPERATION OF THE INVENTION]

To achieve the first object of the present invention, there is provided a method of polishing a substrate comprising steps of rotating a substrate, rotating a polishing pad, polishing a surface of the substrate by contacting the substrate with the polishing pad with providing a slurry to the polishing pad, and eliminating polishing-pollutants resulting from polishing the substrate by flowing a washing liquid vertically and freely to the polishing pad to prevent the washing liquid from rebounding on the polishing pad.

As preferred embodiment of the present invention, the washing liquid is deionized water, and flows vertically and freely onto a surface of the polishing pad along a number of streams, each stream having the same interval.

To achieve the second object of the present invention, there is provided an apparatus for polishing a substrate comprising; polishing station; polishing pad installed to the polishing station and brought into contact with a substrate to polish the substrate; and washing member located at one side of the polishing pad and having at least one feeding hole for providing a washing liquid to the polishing pad, the washing liquid flowing vertically and freely onto a surface of the polishing pad through the feeding hole in order not to be rebounded from the surface of the polishing pad and eliminating polishing-pollutants resulting from polishing the substrate.

According to a preferred embodiment of the present invention, the washing liquid flows vertically and freely onto the polishing pad and the washing liquid is prevented from rebounding, which makes rebounding area of the washing liquid minimize. And therefore, the rebounding of the slurry due to the rebounding of the washing liquid can also be minimized.

As a result, stacked slurry due to the rebounding of the slurry is reduced, and which reduces the source of a defect in polishing process

Hereinafter, preferred embodiments of the present invention will be explained in detail with reference to the attached drawings.

FIG. 4 is a perspective view illustrating an apparatus for polishing a substrate according to a preferred embodiment of the present invention;

Referring to FIG. 4, an apparatus for polishing a substrate 40 includes polishing station 400 where polishing pad 410 is mounted. The polishing pad 410 contacts with substrate 430 and polishes a surface of the substrate 430.

FIG. 5 is a perspective view of a polishing pad of FIG.4.

Referring to FIG. 5, the polishing pad 410 is mounted on platen 460 and

connected to the second rotating member 450 which can rotate polishing pad 410. The rotating member 450 includes a motor (not shown). Therefore, when polishing the surface of the substrate 430, the polishing pad 410 can rotate.

The apparatus for polishing a substrate 40 has carrier head 420 which catches the substrate 430. The carrier head 420 catches the substrate 430 with vacuum pressure at the other side of the surface to be polished, moves up and down above the polishing pad 410, and moves the substrate 430 to contact with the polishing pad 410. When the surface of the substrate 430 is polished, the carrier head 420 rotates and oscillates to the left and right. So, the carrier head 420 is connected to the first rotating member 440 which rotates carrier head 420.

The apparatus for polishing a substrate 40 includes a pad conditioning (not shown) which can dress the surface of the polishing pad 410 during the polishing process. The polishing pad 410 contacts with the substrate 430, and so the polishing pad 410 can damage the substrate 430 in case the surface of polishing pad 410 is worn. Therefore, the pad conditioning dresses the surface of the polishing pad 410 during the polishing process.

The apparatus for polishing a substrate 40 includes washing member 500 providing washing liquid onto the polishing pad 410 when the substrate 430 is polished. The washing liquid includes deionized water.

FIG. 6 is a schematic cross-sectional side view showing a washing member for the apparatus for polishing a substrate according to a preferred embodiment of the present invention and FIG. 7 is a perspective view of a washing member of FIG.6.

Referring to FIG. 6 and FIG. 7, the washing member 500 includes several feeding holes 510 to supply deionized water 515 onto the polishing pad 410. In this

case, the washing member 500 has more than six feeding holes 510 and preferably has more than ten feeding holes 510, because the deionized water 515 is supplied onto the polishing pad 410 uniformly. And the diameter of the feeding holes 510 is about 2mm. A washing liquid outlets 510a to supply deionized water 515 on the polishing pad 410 is located at the end of the washing member 500. So, the deionized water 515 can be flowed up to the center of the polishing pad 410. And the washing member 500 is fixed to the polishing station 400 by a screw 520, and so, the washing member 500 can be fixed and unfixed easily and the height of the washing member 500 is adjustable. Therefore, the washing member 500 can be installed to supply deionized water 515 at more than 20mm high from the surface of the polishing pad 410.

The washing member 500 supplies deionized water 515 on the polishing pad 410 through the feeding holes 510 during the polishing process. Particles generated by the polishing process and slurry used during the polishing process usually cause a defect and so have to be removed. So, during the polishing process, the particles and slurry are removed by the supplying of deionized water 515. The deionized water 515 flows down from the polishing pad 410 carrying the particles and slurry. The deionized water 515 can also flows easily at the point of the polishing pad 410 where the washing member 500 supplies deionized water 515, because the washing member 500 is fixed at more than 20mm high from the surface of the polishing pad 410.

The apparatus for polishing a substrate 40 includes a slurry dispenser 530 which provides slurry 538 onto the polishing pad 410. The slurry dispenser 530 is installed to the washing member 500 and a slurry outlet 535 of the slurry dispenser 530 is located at the end of the washing member 500. The slurry dispenser 530 can include several slurry outlets.

FIG. 8 is a schematic cross-sectional side view of slurry dispenser mounted on a washing member of FIG.6

Referring to FIG. 8, the slurry outlet 535 is located at the edge of the slurry dispenser 530. So, the slurry is supplied to various points on the surface of the polishing pad 410.

A method of polishing a substrate with above mentioned apparatus for a polishing 40 is as follows.

First, the carrier head 420 carrying the substrate 430 is rotated and then the polishing pad 410 is rotated. Subsequently, the substrate 430 is brought into contact with the polishing pad 410 by moving the carrier head 420. Accordingly, the surface of the substrate 430 is polished up on the polishing pad 410. At this time, the slurry 538 is supplied on the polishing pad 410. Therefore, the substrate 430 is polished mechanically by the slurry 538 and the abrasive surface of polishing pad 410, and polished chemically by the chemical materials included in the slurry 538. And, simultaneously with the supply of the slurry 538, several streams of washing liquid are supplied through the feeding holes 510 of the washing member 500 to the surface of the polishing pad 410. As a preferred embodiment of the washing liquid, deionized water 515 is used. At this time, the several streams of the deionized water 515 flows to the polishing pad vertically and freely to prevent the deionized water 515 from rebounding on the polishing pad. As a result, the several streams of the deionized water 515 removes the remaining particles and slurry on the polishing pad 410. And furthermore, the several streams of the deionized water 515 flows to the polishing pad 410 for 1 to 5 seconds continuously after the substrate is polished to eliminate remaining slurry and polishing pollutants. Preferably, the deionized water 515 flows

vertically and freely at 20 to 40 mm high from the surface of the polishing pad 410.

FIG. 9 is a schematic diagram illustrating the spray of washing liquid according to a preferred embodiment of the present invention.

Referring to FIG. 9, the deionized water 515 supplied onto the polishing pad 410 vertically and freely. So, the deionized water 515 supplied onto the polishing pad 410 flows down on the surface of polishing pad 410 without rebounding. Especially, because the washing member 500 includes several feeding holes 510, the deionized water 515 supplied through the feeding holes 510 forms several water streams. Also, the several water streams have same intervals each other because the feeding holes 510 are arranged to have same intervals each other.

The rebounding of the deionized water 515 can be minimized by making the deionized water 515 flow freely and vertically through the feeding holes 510 of the washing member 500. Accordingly, the slurry rebounded with the deionized water 515 can also be minimized, which reduces particles and other source of the defect due to the slurry.

In fact, compared with the case deionized water is sprayed through nozzles in an actual operation, more than 80% of the particles remaining inside of the polishing apparatus and on the washing member is reduced in the case deionized water flows through the feeding holes 510 freely and vertically. The verified measurement data are shown on Table 1 and Table 2. Table 1 is the number of particles remaining inside of the polishing apparatus, and Table 2 is the number of particles remaining on the washing member 20mm high from the surface of the polishing pad.

[Table 1]

	Spraying through nozzles		Free flow through feeding holes	
Size of the particles(μm)	First measurement	Second measurement	First measurement	Second measurement
0.1	283,377	327,019	50,163	58,240
0.2	139,920	225,494	17,080	25,637
0.3	10,112	53,411	7,129	9,162
0.5	2,902	22,530	2,017	2,450
0.7	1,708	14,174	1,257	1,336
1.0	685	6,564	664	660

The number of particles in Table 1 is measured for one minute with laser particle counter. Referring to Table 1, 84% of the number of particle is reduced compared with the case of spraying through nozzles. Therefore, we can confirm that particles due to the rebounding of slurry are reduced by free and vertical flow of deionized water.

[Table 2]

	Spraying through nozzles		Free flow through holes	
Size of the particles(μm)	First measurement	Second measurement	First measurement	Second measurement
0.1	377,199	354,827	88,358	93,578
0.2	252,043	217,593	25,308	18,207
0.3	55,610	46,617	10,784	7,894
0.5	26,560	20,016	3,352	1,855
0.7	17,606	12,856	2,002	1,302
1.0	8,250	6,132	1,038	759

The number of particles in Table 2 is measured for one minute with laser particle counter. Referring to Table 2, 82% of the number of particle is reduced compared with the case of spraying through nozzles. Therefore, we can confirm that particles due to the rebounding of slurry are reduced by free and vertical flow of deionized water.

And after finishing the polishing process, the surface of the polishing pad is washed by continuous free flow of deionized water for one second or five seconds.

Additionally, by positioning the slurry dispenser aside from the center of the polishing pad, washing efficiency can be improved and so, polishing efficiency can be improved as a result.

The improvement of polishing efficiency contributes to the uniformity on the polished surface of the substrate. In an actual operation, in case the washing member according to the preferred embodiment of the present invention is used, the surface deviation of substrate is reduced by 173.5Å compared with the case of conventional

washing member is used. That is, measured surface deviation of substrate is 652.6Å in conventional case and 479Å in present invention.

Accordingly, due to free and vertical flow of the deionized water on the polishing pad, the amount of rebounded deionized water can be minimized and, the slurry rebounded with deionized water can also be minimized. Therefore, particles and other source of defect due to the stack of rebounded slurry can be minimized.

And the washing member is repaired conveniently because the washing member can be fixed by screw joint and so can be unfixed with ease. In an actual case, repairing time of the washing member is reduced from more than 1 hour to less than 30 minutes.

[EFFECT OF THE INVENTION]

According to a preferred embodiment of the present invention, during the polishing process the deionized water for removing the particles and slurry remaining on the polishing pad is flowed onto the polishing pad freely and vertically. Therefore, amount of the deionized water rebounded on the polishing pad can be minimized, and amount of the slurry rebounded with the deionized water can be minimized. The rebounded area of the deionized water can also be minimized.

Accordingly, defect due to the rebounded slurry can be minimized and we can expect improvement of reliability of semiconductor device. And we can expect improvement in efficiency of the polishing process due to the convenient repair of the washing member and the apparatus for polishing a substrate.

As stated above, preferred embodiments of the present invention are shown and described. Although the preferred embodiments of the present invention have been described, it is understood that the present invention should not be limited to these

preferred embodiments but various changes and modifications can be made by one skilled in the art within the spirit and scope of the present invention as hereinafter claimed.

[CLAIM]

[CLAIMS 1]

A method of polishing a substrate, said method comprising steps of:

rotating a substrate;

rotating a polishing pad;

polishing a surface of the substrate by contacting the substrate with the polishing pad with providing a slurry to the polishing pad; and

eliminating polishing-pollutants resulting from polishing the substrate by flowing a washing liquid vertically and freely to the polishing pad to prevent the washing liquid from rebounding on the polishing pad.

[CLAIMS 2]

The method of polishing a substrate as claimed in claim 1, further comprising the step of flowing the washing liquid vertically and freely to the polishing pad for 1 to 5 seconds after the substrate is polished to eliminate remaining slurry and polishing pollutants.

[CLAIMS 3]

The method of polishing a substrate as claimed in claim 1, wherein the washing liquid is deionized water.

[CLAIMS 4]

The method of polishing a substrate as claimed in claim 1, wherein the washing liquid flows vertically and freely onto a surface of the polishing pad along a number of

streams, all of the streams having same interval each other.

[CLAIMS 5]

The method of polishing a substrate as claimed in claim 1, wherein the washing liquid flows vertically and freely at about 20 to 40 mm high from the surface of the polishing pad.

[CLAIMS 6]

The apparatus of polishing a substrate comprising:

polishing station ;

polishing pad installed to the polishing station and brought into contact with a substrate to polish the substrate ; and

washing member located at a side of the polishing pad and having at least one feeding hole for providing a washing liquid to the polishing pad, the washing liquid flowing vertically and freely onto a surface of the polishing pad through the feeding hole in order not to be rebounded from the surface of the polishing pad and eliminating polishing pollutants resulting from polishing the substrate.

[CLAIMS 7]

The apparatus of polishing a substrate as claimed in claim 6, further comprising a carrier head catching the substrate by a vacuum pressure and bringing the substrate into contact with the polishing pad by moving upwardly and downwardly above the polishing pad.

[CLAIMS 8]

The apparatus of polishing a substrate as claimed in claim 7, further comprising a first rotating member connecting to the carrier head and making the carrier head rotate.

[CLAIMS 9]

The apparatus of polishing a substrate as claimed in claim 6, further comprising a second rotating member connecting to the carrier head and making the carrier head rotate.

[CLAIMS 10]

The apparatus of polishing a substrate as claimed in claim 6, further comprising a slurry dispenser providing slurry to the polishing pad while polishing the substrate.

[CLAIMS 11]

The apparatus of polishing a substrate as claimed in claim 10, wherein the slurry dispenser includes a slurry outlet located at an end portion of the washing member.

[CLAIMS 12]

The apparatus of polishing a substrate as claimed in claim 10, wherein the slurry dispenser includes a slurry outlet located at an edge portion of the washing member.

[CLAIMS 13]

The apparatus of polishing a substrate as claimed in claim 6, wherein the

washing member includes more than 6 feeding holes positioning at a predetermined interval each other.

[CLAIMS 14]

The apparatus of polishing a substrate as claimed in claim 6, wherein the feeding hole is about 1.5 to 2.5 mm in diameter.

[CLAIMS 15]

The apparatus of polishing a substrate as claimed in claim 6, wherein the washing member is adapted to flow the washing liquid vertically and freely at 20 to 40 mm high from the surface of the polishing pad.

[CLAIMS 16]

The apparatus of polishing a substrate as claimed in claim 6, wherein the washing member is fixed to the polishing station by screw joint.

[CLAIMS 17]

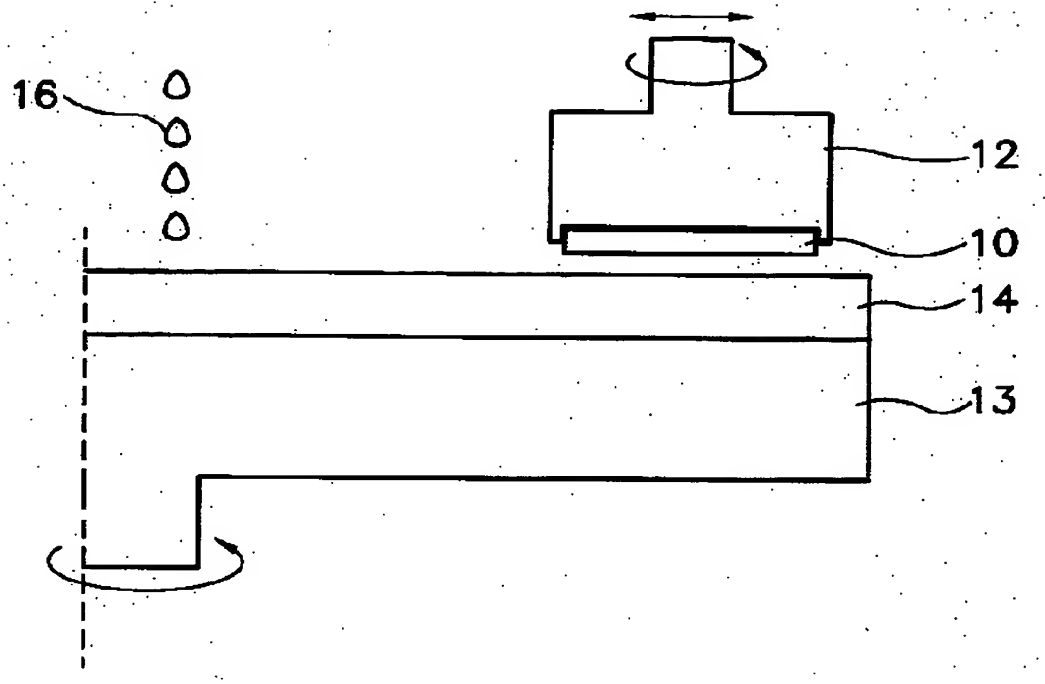
The apparatus of polishing a substrate as claimed in claim 6, wherein a washing liquid outlet is located at an end portion of the washing member, the washing liquid flowing vertically and freely through the washing liquid outlet.

[CLAIMS 18]

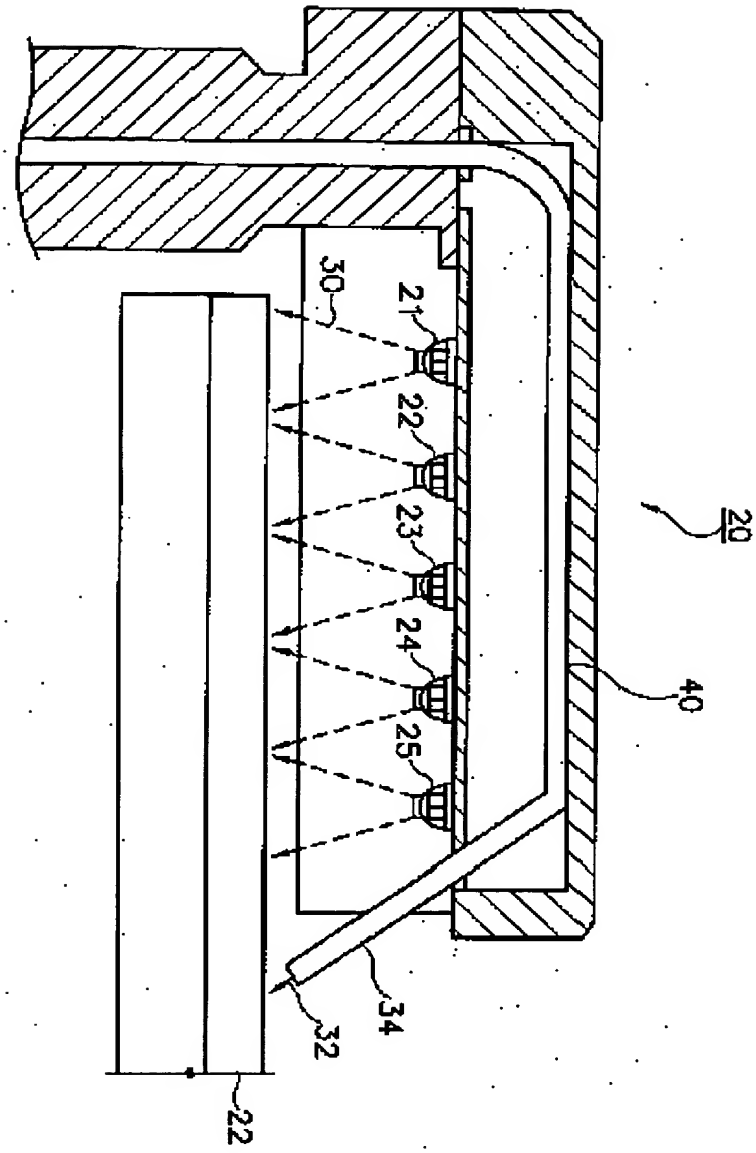
The apparatus of polishing a substrate as claimed in claim 6, wherein the washing liquid is deionized water.

[Drawings]

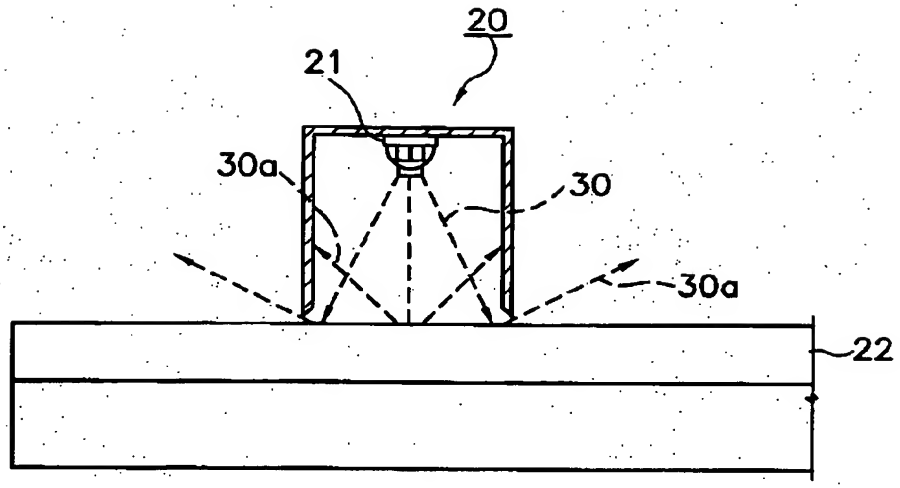
[Fig. 1]



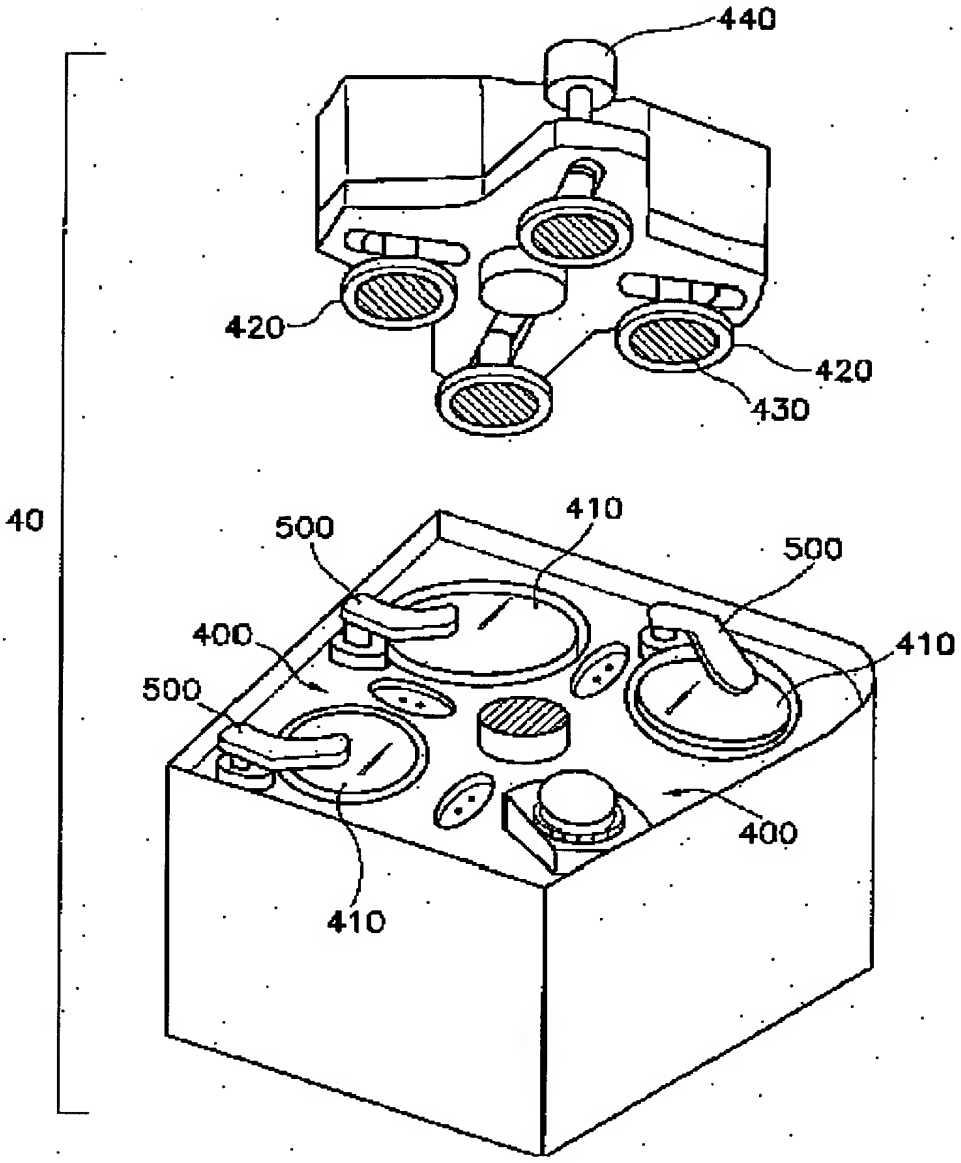
[Fig. 2]



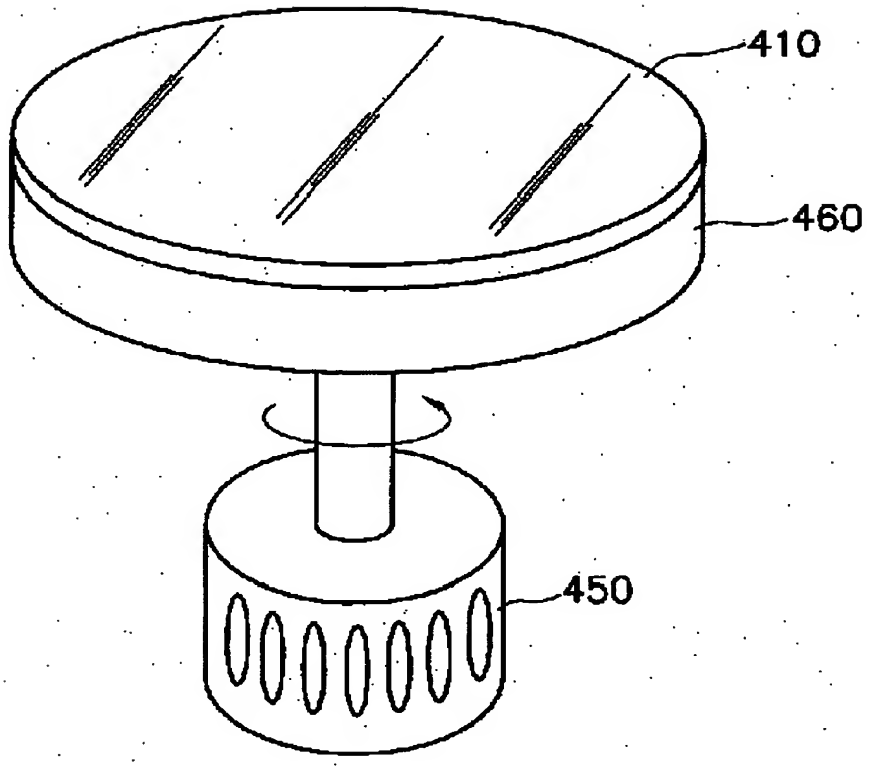
[Fig. 3]



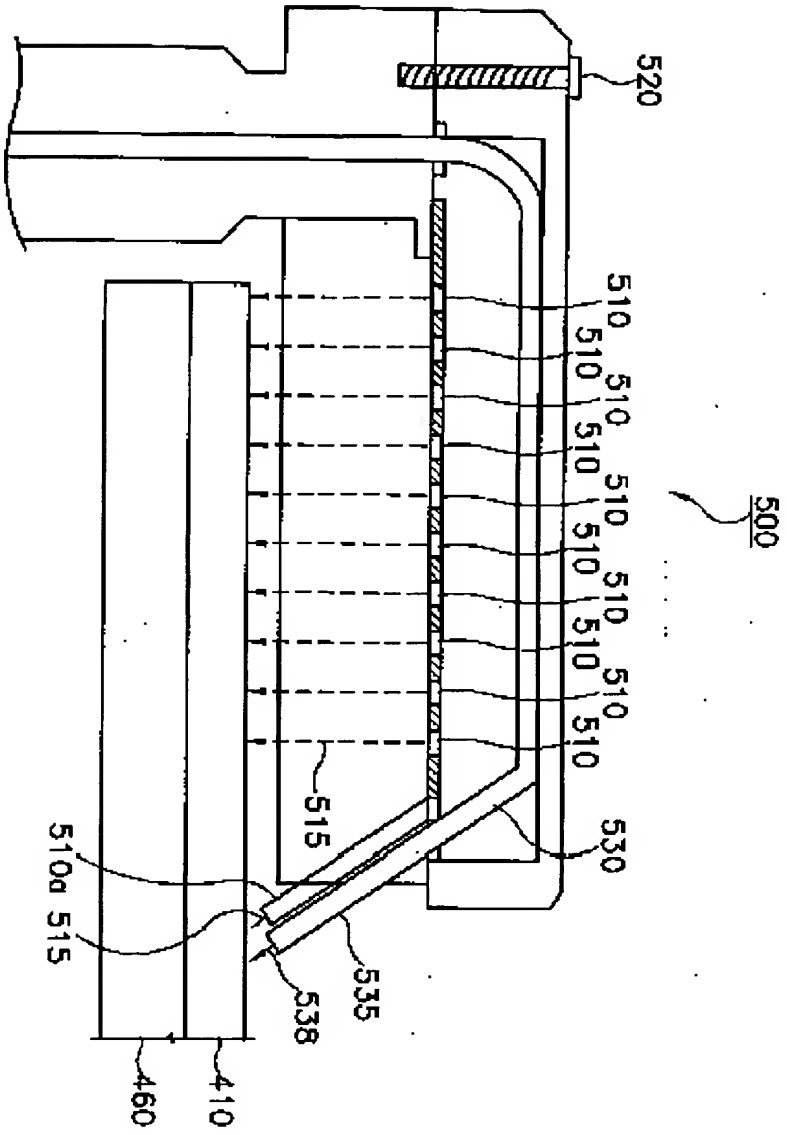
[Fig. 4]



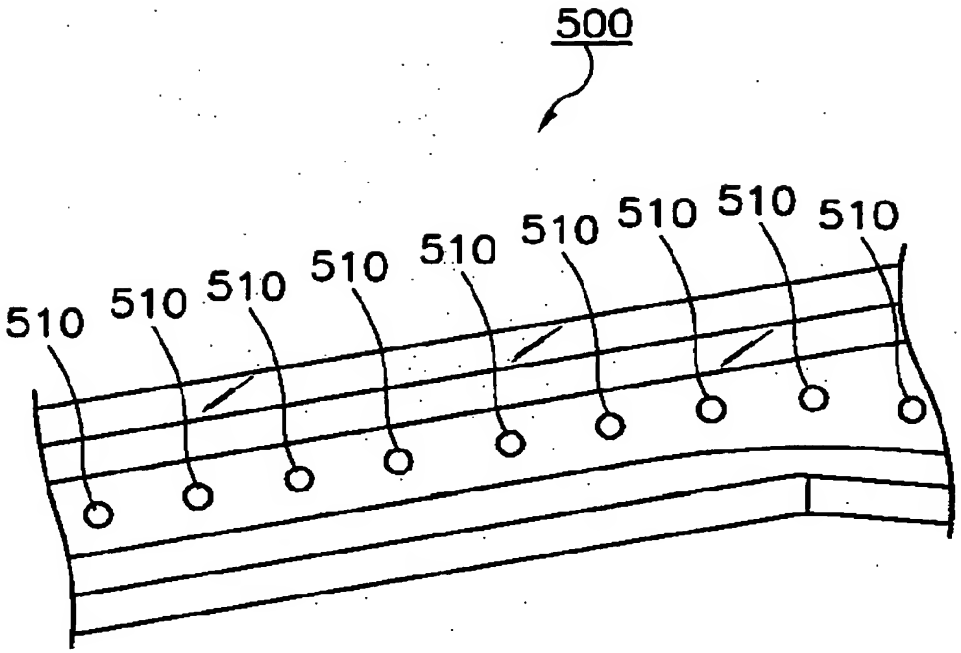
[Fig. 5]



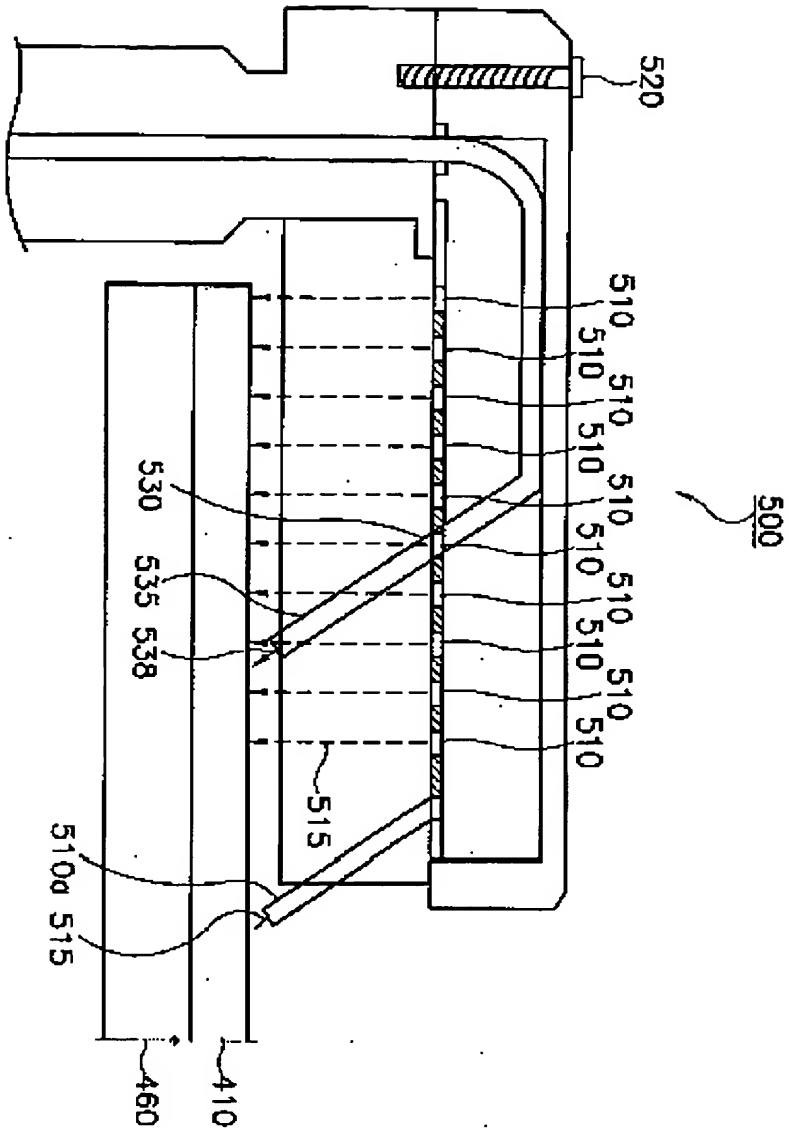
[Fig. 6]



[Fig. 7]



[Fig. 8]



[Fig. 9]